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Tremor Suppression by Using Various Techniques

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General Note

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ABSTRACT

Physiological tremor is one of the main causes for human imprecision during micro surgery. The remote manually operated tasks such as those found in teleportation, virtual reality, or joystick based computer access, requires the generation of an intermediate electrical signal which is transmitted to the control subsystem. Tremor affects the human movement which can be improved by using various techniques. In this paper, least mean square (LMS), Fourier series combiner (FLC) like series of derived algorithms are analysed first, then an improved algorithm on weighted frequency Fourier linear combiner (WFLC) algorithm is proposed. In this paper simulation study is accomplished by using MATLAB and Simulink software.

Keywords: Human Tremor, LMS, FLC, WFLC

1. INTRODUCTION

Tremor is characterized by involuntary oscillations of a part of the body. The most accepted definition is as follows: "an involuntary, approximately rhythmic, and roughly sinusoidal movement" (Veluvolu et al. 2008; Ang et al. 2004). Tremor is the most common movement disorder and is a major source of functional disability, affecting many of the daily living tasks.

Classification,

Categories into four types

- Rest

- Postural
- Kinetic
- Task-specific

The rest tremor is typically observed in Parkinson's disease. Tremor occurs when the affected part of the body is in repose and fully supported against gravity, requiring no voluntary contraction. The postural tremor occurs when the subject attempts to maintain a posture, such as maintaining the upper limbs outstretched. The following conditions are associated with postural tremor: physiological tremor, essential tremor, cerebellar tremor, post-traumatic tremor, peripheral neuropathy. The kinetic tremor occurs during purposeful movement; for example, during finger-to-nose test (the patient is asked to put the index finger on the nose). Kinetic tremor is highly suggestive of a cerebellar disorder (cerebellar ataxia) or a disease involving cerebellar pathways. Midbrain tremor combines rest, postural, and kinetic tremor.

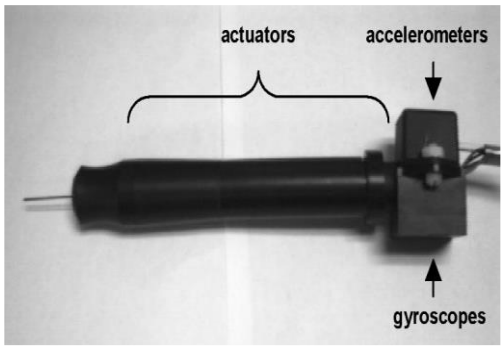

Figure 1

Micron- Handheld Instrument

The task-specific tremor appears when performing goal-oriented tasks such as handwriting, speaking, or standing. This group consists of primary writing tremor, vocal tremor, and orthostatic tremor. Task-specific tremor can be viewed as a form of kinetic tremor that appears during specific tasks. This paper presents the implementation and preliminary error cancelling result by using firstly LMS, FLC which provides better result than LMS & WFLC which overcome the FLC & LMS algorithms. This paper organised as follows, Section II deals with architecture of micron system, Section III deals with related work, Section IV deals with proposed work, Section V deals with simulation, result and comparison, Section VI represents conclusion and Section VII represents references.

2. ARCHITECTURE OF MICRON SYSTEM

The intelligent active vitreoretinal microsurgical instrument is known as 'Micron' as shown in Figure 1 (Veluvolu et al. 2008; Ang et al. 2004), which measures 75 to 150 mm long and 10 to 15 mm in diameter, with an intraocular shaft roughly 30 mm long and 1 mm in diameter. The first prototype weights 170 g and is 210 mm in length (including the 30 mm intraocular shaft) and has an average diameter of 22 mm (Veluvolu et al. 2008). The handle is contoured near the tips as an aid to grasping.

2.1. Motion Sensing System

The motion-sensing module is mounted at the back end of the instrument handle, to detect translation and rotation in six degrees of freedom (Riviere et al. 1998). The sensor suite houses six inertial sensors: a CXL02LF3 tri-axial accelerometer (Crossbow Technology, Inc., San Jose, Ca.) and three CG-16D ceramic rate gyros (Tokin Corp., Tokyo). Data are sampled at 1000 Hz by an ADAC 5803HR data acquisition board. Using the data from these sensors, and assuming the center of rotation to be at the fingertip grasping point, the three-dimensional (3-D) velocity of the instrument tip is obtained via kinematic calculations, and then integrated to obtain tip displacement.

2.2. Erroneous Motion Estimation

Estimation of tremor is performed by a system based on the weighted-frequency Fourier linear combiner (WFLC) algorithm (Riviere et al. 1997). This is an adaptive algorithm that estimates tremor using a dynamic sinusoidal model, estimating its time-varying frequency, amplitude, and phase online. Active canceling of physiological tremor using this algorithm was previously demonstrated using a one degree- of-freedom (1-dof) instrument prototype. In 25 tests on hand motion recorded from eye surgeons, this technique yielded an average rms tremor amplitude reduction of 69% in the 6-16 Hz band, and average rms error reduction of 30% with respect to an off-line estimate of the tremor-free motion (Riviere et al. 1998). Other research within the Micron development effort involves a neural network technique for online estimation of non-tremorous erroneous movement, using the cascade-correlation learning architecture, with extended Kalman filtering being used for learning. This technique has been tested in simulation on recordings of vitreoretinal instrument movement, yielding an average rms error reduction of 44% (Riviere et al. 1998).

2.3. Manipulator System

The tip of the intraocular shaft may be approximated as a point in Euclidean space. We may disregard changes in orientation of the intraocular shaft, since they will be small in any case, given the small workspace of the manipulator. This reduces the dimension of

the configuration space of the manipulator to three, and simplifies the mechanical design and the online computation of inverse kinematics. A parallel manipulator design is best suited to this application because of its rigidity, compactness and design simplicity, as compared to a serial mechanism. The TS18-H5-202 piezoelectric stack actuator (Piezo Systems, Inc., Cambridge, Ma.) was chosen for its high bandwidth and miniature size. The experimental results show that the prototype is able to track 1D and 3D trajectories with rms error of 2.5 µm and 11.2 µm respectively. Detailed design and inverse kinematics of the 3 DOF parallel manipulator can be found in (Gomez-Blanco et al. 1999).

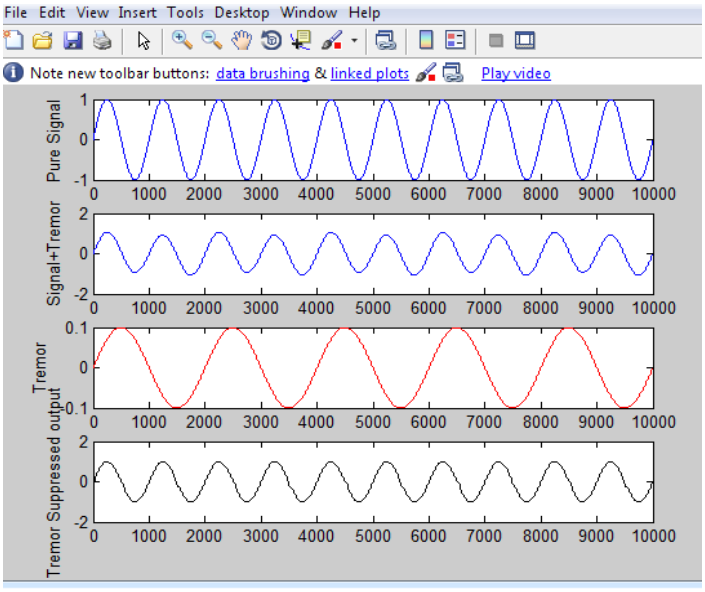

Figure 2
LMS Algorithm

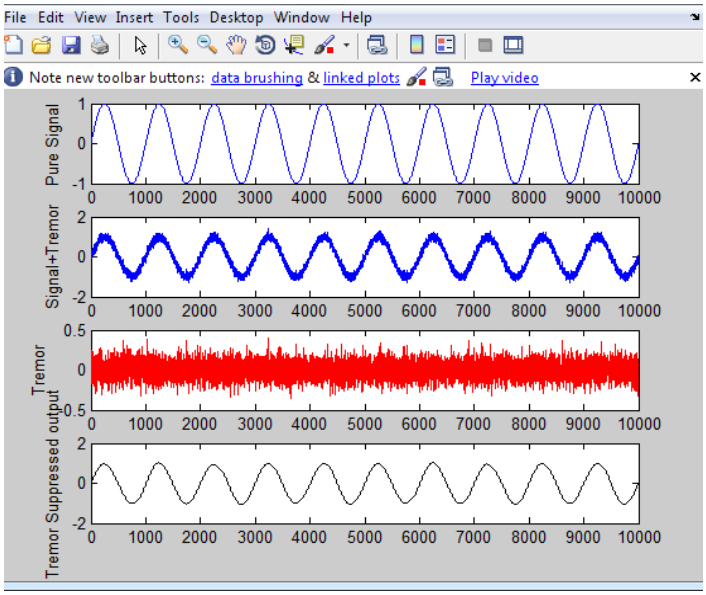

Figure 3
FLC Algorithm

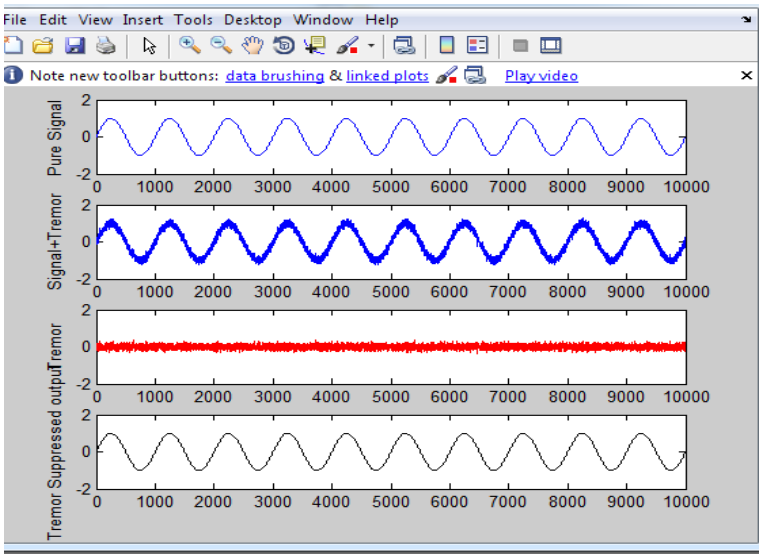

Figure 4
WFLC Algorithm

3. RELATED WORKS

In the previous work various algorithms such as Least Mean Square (LMS), Fourier Linear Combiner (FLC) are compared according to various parameters such as Frequency, amplitude and phase. In this paper we use the Weighted Frequency Fourier Linear Combiner (WFLC) algorithm for tremor suppression and provides the better result and compare with the above two algorithm.

4. PROPOSED WORK

In the Proposed work first we deals with the Least Mean Square (LMS) algorithms in which very small amount of tremor is reduced but requires large time. The Fourier Linear Combiner (FLC) it is good than the LMS algorithms but it is slow and time consume algorithm. Finally the Weighted Frequency Fourier Linear Combiner (WFLC) algorithm is implemented in which the tremor reduction capacity is maximum than the previous two algorithm and it is faster and less time consume.

5. SIMULATION AND RESULT

The tremor suppression is done by WFLC algorithm which is simulated by using Matlab. The figure shows the comparative result of LMS, FLC & WFLC algorithm. In LMS algorithm the number of iteration requires large time, FLC algorithm requires medium time whereas the WFLC algorithm requires very less time for iteration and provides better result as compare to other algorithm. The results are shown in Figures 2-4 & Table 1.

6. CONCLUSION

Implementation of WFLC technique is helpful to minimize the tremor in laparoscopic as well as enhance the accuracy.

REFERENCE

1. Ang WT, Pradeep PK, Riviere CN. Active Tremor Compensation in Microsurgery. 26 th Annual International Conference of the IEEE EMBS San Francisco, 2004
2. Gomez-Blanco M, Riviere CN, Khosla P. Sensing hand tremor in a vitreoretinal microsurgical instrument. Tech. report CMU-RI-TR-99-39, Robotics Institute, Carnegie Mellon University, Pittsburgh, Pa.,U.S.A., 1999
3. Riviere CN, Khosla PK. Active hand-held instrument for error compensation in microsurgery., Proc. Of Intelligent Systems and Manufacturing: Tech. Conf. on Microrobotics and Microsystem Fabrication, Pittsburgh, Pa., U.S.A., pp. 86-95, 1997
4. Riviere CN, Rader RS, Thakor NV. Adaptive canceling of physiological tremor for improved precision in microsurgery,. *IEEE Trans. Biomed. Eng.*, 1998, 45, 839-846
5. Veluvolu KC, Tan UX, Latt WT. Adaptive Filtering of Physiological Tremor for Real Time Compensation. IEEE International Conference on Robotics and Biomimetics Bangkok, Thailand, 2008